



**Industrial Technology  
Research Institute**  

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**Energy & Resources Laboratories**

## **Comparing Apples to Apples**

### **A Standardized Test Procedure for Fan-Filter Units**

Lawrence Berkeley National Laboratory (LBNL) and Energy & Resources Laboratories of the Industrial Technology Research Institute (ERL/ITRI) in Taiwan, are developing a test procedure to allow for consistent performance evaluation of fan-filter units (FFUs) used in cleanrooms. LBNL is involved in research and market transformation activities centered on improving efficiency in energy intensive high-tech buildings. ERL/ITRI has performed considerable testing and development of fan-filter units in addition to many other energy efficiency and technology intensive research projects. Both organizations are collaborating with the goal of creating a method for consistent comparison of operating characteristics of FFU's.

Cleanroom HVAC systems circulate air through HEPA/ULPA filters using fan-filter units to achieve desired air changes and cleanliness. Internationally these components are widely used, and they are becoming increasingly popular in the US. They offer several advantages over other air recirculation configurations. For example, they offer simplified design, flexibility for control and future modifications, reliability for single failure, ease of balancing, and they are readily available. However, their use could also create noise and vibration problems, higher maintenance cost, higher cooling load, and higher operating cost. Historically, owners have not included operating cost in their system-selection criteria. .

This presentation will describe the rationale for a standardized test procedure, the parameters being evaluated, and representative test results. This work builds upon research and testing already undertaken by ERL/ITRI for these components, see Figure 1 for a picture of the test facility.

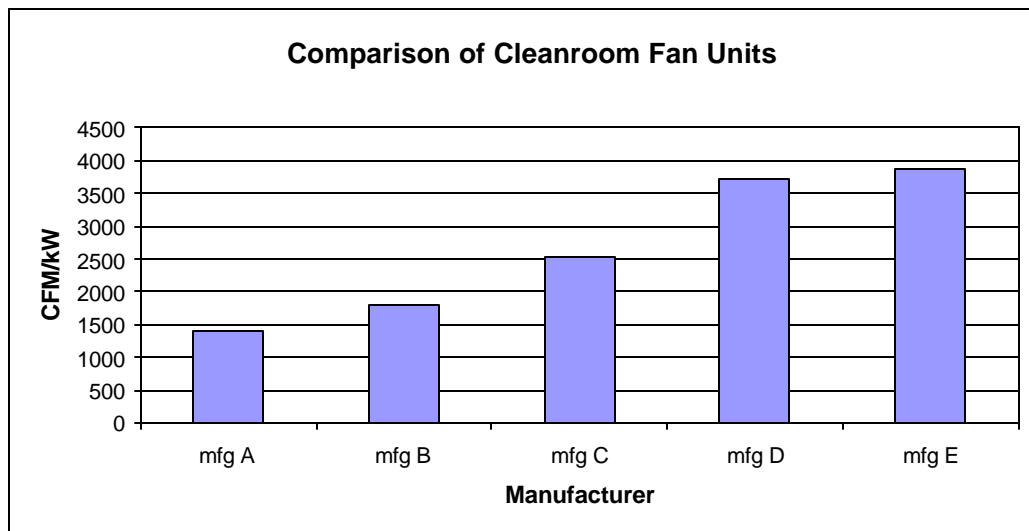
Test results confirm a wide variation in performance of the units tested, supporting the concept that a standardized test method will facilitate valuable comparisons. These tests have included energy efficiency, noise and vibration testing, as well as other parameters. Complementing ITRI's experience, LBNL has performed energy design charrettes for projects utilizing fan-filter units and conducted energy performance benchmarking comparing various configurations. As a result, LBNL has similarly concluded that there is a wide variation in performance and a need to develop standards for measuring and

reporting performance. Manufacturer information also suggests that energy efficiency may vary by a factor of 5 between high- and low- performing units (see Figure 2).

Figure 1



Figure 2



Anecdotal evidence suggests that designers and building operators receive widely varying performance claims and do not have a common basis to make comparisons. Manufacturers' claims are based on various parameters and are often confusing to end-users, making it impossible to compare life-cycle cost (true cost of ownership) and other operational characteristics. For example, many manufacturers report energy use by

providing wattage without reference to the rated air flow rate and pressure. FFU manufacturers have improved the energy efficiency of their units in recent years so efficient FFU re-circulation systems may approach or even surpass the performance of traditional US cleanroom air-recirculation schemes. Designers and building operators, however, have no way of determining which are the better performers.

The standardized rating system being developed will enable designers and end-users to make valid product comparisons and then select units that have the lowest life cycle cost, thereby considering the true cost of ownership.

## **Presenters' Bios:**

### **Fanghei Tsau**

Dr. Tsau is the manager of the Ventilation Systems and Indoor Air Quality Research Laboratory of the Energy & Resources Laboratories (ERL). This is the main research group dealing with energy efficiency, new and renewable energy, and environmental technology issues within the Industrial Technology Research Institute (ITRI) in Taiwan. He has been an R&D project leader for research on fan, fan-filter unit and ventilation system technologies, and holds many local and foreign patents. He now leads the Ventilation Systems and Indoor Air Quality Research Laboratory that has a 23-member research and engineering staff and several standardized and accredited experimental facilities, including an AMCA Laboratory. He received his Ph.D. and MS degrees from the School of Aerospace Engineering of Georgia Institute of Technology and previously worked for UC-Irvine.

### **William Tschudi**

Mr. Tschudi is a member of the Applications Team in the Environmental Energy Technologies Division at Lawrence Berkeley National Laboratory. The applications team applies research and emerging technology in real world situations. He is a licensed mechanical engineer with over 30 years of experience in design of high tech facilities, industrial facilities, and power plants. Previously, Mr. Tschudi managed multi-disciplined engineering offices and projects for leading firms in design of clean room facilities. Mr. Tschudi currently leads LBNL's cleanroom energy efficiency program; is a corresponding member of the ASHRAE TC 9.11 committee on clean spaces; and is a member of ASME.